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82-4.02(01) Guardrail

Temporary guardrail installations for an Interstate project should be in accordance with the permanent installation criteria in Chapter Forty-nine and the INDOT *Standard Drawings*, except as shown in Figure 82-4B, Clear Zone Distances (m) (Construction Project). For a short-term construction project, the installation of new temporary guardrail is usually not practical.

The following should be used to determine the temporary guardrail length on all four corners of a temporary bridge in a two-lane runaround. For a construction zone design speed of 70 km/h or lower, the minimum guardrail length is 15.24 m. For a construction zone design speed of 80 km/h or higher, the minimum guardrail length is 30.48 m.

A temporary guardrail run should continue until the guardrail warrants for an embankment shown in Section 49-4.04 are satisfied. The design speed, and not the construction zone design speed, should be used to determine guardrail warrants for an embankment.

82-4.02(02) Temporary Traffic Barrier (TTB)

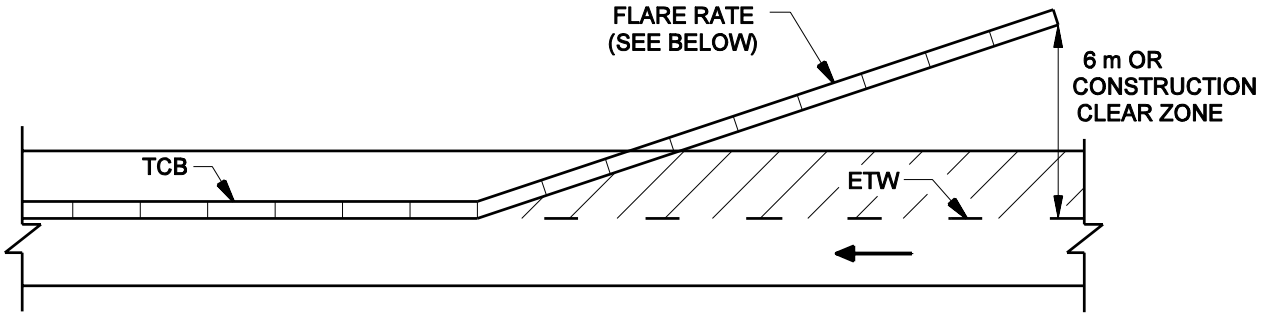
A TTB is used to provide protection to motorists and workers in the work zone. The primary functions of TTB are as follows:

1. to separate two-way traffic;
2. to protect workers and pedestrians;
3. to keep traffic from entering a work area (e.g., excavation, storage site); and
4. to protect construction elements (e.g., bridge falsework, exposed objects).

1. Types of TTB.

   a. Type 1. This type is used only to separate two-way traffic.

   b. Type 2. This type is used to separate traffic from the work zone. It should be used to protect traffic from any obstruction, including an elevation differential of greater than 150 mm, which is within the construction clear zone. It should also be used to shield traffic from extreme hazards during construction that may necessitate consideration of a barrier between the construction clear zone and the permanent clear zone. For this situation, the designer should consider the



Construction Zone Design Speed (km/h)	Flare Rates
≤ 60	10:1
70	12:1
80	14:1
90	16:1

FLARE RATES FOR TEMPORARY CONCRETE MEDIAN BARRIER
(Construction Zones)

Figure 82-4A

construction zone design speed, the extent of the obstruction, and the potential for an elevation differential, and use engineering judgment in determining whether a TTB is necessary.

c. Type 3. This is type 1 TTB which is to be left in place upon completion of the contract and become the property of the Department.

d. Type 4. This type is used as a readily movable device to accommodate the shifting of traffic lanes possibly on a daily basis to better facilitate the directional distribution or other changing volumes of traffic during a day's peak hours. The barrier layout and signage for each phase, a staging-area diagram, and the location of the barrier-moving apparatus when it is not in use should be shown on the traffic control plan. The size of the barrier-moving apparatus should be taken as 15 m long by 5 m wide.

2. Construction Clear Zone and Flaring Considerations. The terminal end of a TTB type 1, 2, or 4 should be flared away from the traveled way to a point outside the construction clear zone. Construction clear zone distances are shown in Figure 82-4B. The potentially hazardous conditions typically found within a construction zone warrant the use of considerable judgment when applying one of these widths. It is not necessary to adjust such width for horizontal curvature.

Figure 82-4A, Flare Rates for Temporary Traffic Barrier, should be used to determine the desirable flare rate for the TTB based on the construction zone design speed, and not a lower worksite speed limit.

If a flared portion of TTB type 1 cannot be designed to end outside the construction clear zone, an acceptable construction zone energy absorbing terminal as described in Section 83-4.02(03), Item 1, is required. A unit which has been successfully crash tested in accordance with NCHRP 350 Test Level 2 should be specified if the construction zone design speed is 70 km/h or lower. A unit which has been successfully crash tested in accordance with NCHRP 350 Test Level 3 should be specified if the construction zone design speed is 80 km/h or higher.

For a TTB type 2 or 4, if field conditions such as public road approaches or drives render the desirable flare rate impractical, the flare rate may range between 10:1 and 6:1. For a TTB type 2, the flare may be eliminated if the sharper flare rate cannot be attained. Such locations and flare treatments should be shown on the traffic control plan.

3. Glare Screen. A glare screen may be used in combination with TTB type 1 or type 3 to eliminate headlight glare from opposing traffic. The typical applications are at crossover transitions or in a 2-way, 2-lane operation. Guidance regarding consideration of glare screens is described in Section 49-4.05(03), though INDOT has not adopted specific warrants for the use of glare screens.

4. Anchoring. TTB type 1, 2, or 3 should be anchored where indicated on the INDOT *Standard Drawings*. The locations of anchored TTB should be shown on the plans.

5. Traffic-Control-Plan Information. Types, locations, and quantities of TTB, including locations and quantities of glare screens and energy absorbing terminals, along with flare rates should be shown on the traffic control plan for each traffic-maintenance phase.

See Section 17-3.13 for information regarding determination of pay quantities.

82-4.02(03) End Treatments

The following discusses several end treatments that may be used.

1. Energy Absorbing Terminal. The use of a construction zone energy absorbing terminal should be based on National Cooperative Highway Research Program *Report 350* Test Levels. The Test Level 3 (TL-3) terminal should be specified for an Interstate or other route with a construction zone speed limit of 45 mph or higher. The TL-2 terminal should be specified for a non-Interstate route with a construction zone speed limit of 40 mph or lower. If a lower temporary worksite speed limit is to occasionally apply, all terminals' Test Levels should still correspond to those for the construction zone speed limit. Locations of terminals with their Test Levels should be shown on the TCP.

2. Guardrail. The treatments for an exposed guardrail end include the following:

   a. Connection to existing barrier;
   b. using an acceptable end treatment. Use the construction year AADT, and see Section 49-5.04(01);
   c. flaring the end to a point outside of the construction clear zone; or
   d. burying the end in the backslope.

3. Gravel Barrel Array. Due to its size, a gravel barrel array generally has limited application in a construction-work zone.

4. Other. Other INDOT-approved end treatments may be applicable. Chapter Forty-nine provides information on some of these end treatments used by the Department. Provide the most applicable end treatment consistent with cost and geometric considerations.

82-4.03 Design/Layout

Where practical, temporary roadside safety appurtenances should be designed and located as determined in Chapter Forty-nine (e.g., deflection distance, length of need). However, it is usually not cost effective to meet these permanent installation criteria due to the limited time a motorist is exposed to construction hazards. The designer must evaluate the exposure time of the hazard in determining the need for installing a roadside safety appurtenance. The following offers several alternatives that may be considered in designing and locating temporary roadside safety appurtenances within a construction zone.

1. Construction Clear Zone. Applying the clear-zone distance as presented in Chapter Forty-nine to a construction work zone is often impractical. Therefore, INDOT has developed revised construction clear-zone distances which are presented in Figure 82-4B. However, the potentially hazardous conditions typically found within a construction zone warrant the use of considerable judgment when applying these clear-zone distances. Note that it is not necessary to adjust the clear-zone values presented in Figure 82-4B for horizontal curvature.

2. Shoulder Widening. Where a temporary barrier is placed adjacent to the shoulder, it is not necessary to provide extra shoulder widening.

3. Flare Rate. Desirably, the TCB terminal should be flared beyond the traveled way to a point outside of the construction clear zone. Figure 82-4A presents the desirable flare rates for the TCB based on the selected construction-zone design speed. These flare rates should be provided unless extenuating circumstances render this impractical (e.g., stop conditions, driveways, intersections). See Section 82-4.03.

4. Openings. Openings in the barrier should be avoided. Where openings are necessary, barrier ends should have an acceptable end treatment as discussed in Section 83-4.03(03).

Construction Zone Design Speed	Cut Slopes					Fill Slopes			
	3:1	4:1	5:1	6:1	Flatter Than 6:1	6:1	5:1	4:1	3:1
60 km/h or less	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3.0	See Note 2
70 km/h	2.5	2.5	2.5	2.5	2.5	2.5	3.0	3.0	3.5	
80 km/h	2.5	3.0	3.0	3.0	3.0	3.0	3.5	4.0	4.5	
90 km/h	2.5	3.5	3.5	3.5	3.5	3.5	4.0	4.5	5.5	

Notes:

1. *All distances are measured from the edge of traveled way.*
2. *For a facility with 3:1 fill slopes, the clear zones above should be used in conjunction with the procedures in Section 49-2.03(01).*

CLEAR ZONE DISTANCES (m)
FOR CONSTRUCTION PROJECT

Figure 82-4B

82-4.04 Pavement Edge Dropoffs on a Multilane Divided Highway

Pavement edge dropoffs should be avoided immediately adjacent to lanes open to traffic during construction activities such as shoulder rehabilitation and crossover construction.

When developing a traffic maintenance plan, the preferred option is to close the lane adjacent to an edge dropoff. This will ensure that the edge dropoff is located beyond the recommended construction clear zone.

If the traffic lane adjacent to the edge dropoff cannot be closed for an extended period of time, a full-depth shoulder rehabilitation section should be provided that can be placed to within 75 mm of the top of pavement elevation by the end of the work period. This should be done, for example, where the shoulder work is to be done at night so that all of the existing traffic lanes can be kept open during daylight hours. The pavement section required to fill a shoulder dropoff to within 75 mm of the top before exposure to adjacent traffic should be obtained from the Planning Division's Office of Pavement Engineering. A unique special provision will be required to address the time frames imposed on the contractor for bringing the shoulder paving up to the required grade. Also, drums should be placed on the shoulder dropoff, spaced as shown in Figure 83-3D, Suggested Maximum Spacing of Channelization Devices.

Where it is not feasible to limit exposure to the edge dropoff by the means described above, and the edge dropoff is greater than 75 mm, one of the mitigating measures should be considered as follows:

1. Placing a temporary wedge of material along the face of the dropoff. The wedge should consist of asphalt material placed at a 45-deg angle or flatter. Warning signs should be placed in advance of and throughout the treatment. A 150-mm width solid edge line should be used to delineate the edge of the travel lane.

2. Placing drums along the traffic side of the dropoff and maintaining, if practical, a 1-m width buffer between the edge of the travel lane and the dropoff. Warning signs should be placed in advance of and throughout the treatment.

3. Installing temporary concrete barriers or other acceptable positive protection with a buffer between the barrier face and the traveled way. An acceptable crashworthy terminal or flared barriers should be installed at the upstream end of the section. For nighttime use, standard delineation devices must supplement the barriers. Specifying the use of a temporary movable concrete barrier system will generally involve the use of proprietary materials.

On a project involving deep milling or asphalt pavement replacement, and a dropoff greater than 40 mm between adjacent lanes, mitigating measure No. 1 or No. 2 should be considered.

bridge structure impact damage, roadside appurtenances, and slope stability. Notification of the closure must satisfy current Departmental procedures.

7. Routine District Maintenance. Some non-contractual routine maintenance activities, such as crack sealing, pavement markings, raised-pavement-markers restoration, etc., are performed on a recurring basis by district maintenance forces. Such activities are exempt from this policy and are addressed under a separate *District Maintenance Interstate Lane Closure Policy* developed by the districts and the Construction Management Division.

8. Queue Analysis. The criterion used to determine the impact of a proposed work zone will be queue length. QuickZone, Quewz-92, Synchro/Simtraffic, Corsim, or similar programs may be used to model the expected queues that may be generated. Multiple stages of construction should be analyzed for each of the traffic-maintenance phases. The speed limit used in the computer models should be the posted legal construction-zone speed limit. Volume data supplied by INDOT for input into the models should be current (not older than three years), should account for seasonal traffic surges that may occur during construction, and should reflect current regional traffic patterns. Traffic volumes should be expanded to construction-year levels through the use of growth factors. In an urban area where congestion occurs under normal unrestricted conditions, the queue length should be considered.

   Use of a microscopic model (Synchro/Simtraffic, Corsim, etc.) is encouraged for modeling of work zone queues. The effect of significant ramp merges on queues should be included in the model.

   A vehicle will be considered part of a queue if its average operating speed is approximately 15 km/h or less. Discretion is required during both the analysis portion and field evaluation of the implemented work zone in determining what constitutes a queue. A condition that causes driver frustration due to stop-and-go operations should be considered a queue.

   The following thresholds should be used for the evaluation of project queue lengths as determined by the computer model.

   a. For a queue shorter than 1.6 km, the work zone impacts are acceptable.

b. For a queue of 1.6 km or longer but shorter than 2.5 km, the work zone impacts are acceptable if the queue exceeds 1.6 km for 2 h or less. Where a queue is expected, additional advanced work zone warning signing should be specified.

c. For a queue of 1.6 km or longer for more than 2 h, or for a queue of 2.5 km or longer for any period of time, the work zone impacts are unacceptable. Alternate strategies should be considered based on this policy.

82-6.04 Runarounds and Detours

In addition to the criteria on the INDOT *Standard Drawings*, a temporary runaround or specially-built detour should meet the geometric and roadside safety criteria presented in Sections 82-3.0 and 82-4.0.

The embankment for a temporary runaround should be shown on the mainline cross sections.

If the AADT is 5000 or greater, or if the percent trucks is 10% or greater, a project-specific pavement design is required for a temporary runaround. See the INDOT *Standard Drawings* for the pavement section to be used if the AADT is less than 5000, or if the percent trucks is less than 10%.

A temporary runaround should comply with the design criteria included herein. The following Level One elements shall meet the criteria as follows:

	Elements	Design Criteria
1.	Design speed	Section 82-3.01
2.	Lane width	Section 82-3.02
3.	Shoulder width	Section 82-3.02
4.	Bridge width	Standard Specifications Section 713.04
5.	Structural capacity	Standard Specifications Section 713.04
6.	Horizontal curvature	Figure 82-3A
7.	Superelevation transition length	Section 82-3.05 and Chapter 43

8a.	Stopping sight distance at horizontal curve	Section 82-3.04. Design speed should be used in the construction zone. Section 43-4.0
8b.	Stopping sight distance at vertical curve	Sag: Section 82-3.06; Crest: Section 82-3.04 and Chapter 44.
9.	Maximum grade	3R criteria for the design speed for the construction zone, appropriate functional classification, and rural/urban.
10.	Through-lane cross slope	3R criteria for the appropriate functional classification and rural/urban. If the existing shoulder is used for through traffic, 4% cross slope will be acceptable.
11.	Superelevation rate	Section 82-3.05
12.	Vertical clearance	3R criteria for the appropriate functional classification.
13.	Americans with Disabilities Act requirements	Section 51-1.08, where sidewalks exist prior to construction.
14.	Bridge railing safety performance	Standard Specifications Section 713.14

If the design for a temporary runaround or other traffic-maintenance means does not meet the above criteria, a design exception must be requested. The procedure established in Section 40-8.0 should be followed.

The INDOT reviewer should verify that the above criteria are met as part of the limited review of a consultant-designed project.

The design speed for the construction zone should be shown on the first sheet of the Traffic Maintenance Plan. The designer should coordinate with the appropriate district traffic engineer to establish the design speed for the construction zone for an INDOT route or with the local public agency's engineer for a local agency project.

A traffic control plans check list is shown as Figure 82-7A. An editable version of this form may also be found on the Department's website at www.in.gov/dot/div/contracts/design/dmforms/.